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REPORT NO T 2/82

ANALYSIS OF ATRITION, RETENTION AND CRITERION TASK PERFORMANCE OF RECRUITS DURING TRAINING

US ARMY RESEARCH INSTITUTE OF ENVIRONMENTAL MEDICINE
Natick, Massachusetts

FEBRUARY 1982

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Present research evaluated aspects of task performance, physical work capacity, biographical data, and psychological coping strategies, to determine their relationship to attrition and retention of personnel during a stressful training program.

It attempted to develop a selection instrument that could be utilized as part of a pre-training screening device to optimize both personnel selection and subsequent occupational assignment and training in the US Armed Forces.

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The results suggest that even with reasonable limitations of the multivariate model, in terms of cost effectiveness, it may be a useful tool for the identification of female dropouts and the prediction of task performance in a stressful training environment. The application of the findings to the personnel recruitment, selection and training process has varied implications.

Analysis of Attrition, Retention and Criterion Task Performance of Recruits During Training

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FOREWORD

The research reported herein represents the first of a series of studies resulting from a tasking from the Office of the Deputy Chief of Staff for Personnel dated 25 July 1977. The tasking requested our laboratory ...." develop, for pilot testing, a battery of physical fitness tests suitable for screening new accessions for MOS classification during the AFEES medical examination". Since the time of this research MOS physical requirements were not yet available, possible fitness screening items were evaluated against the criterion variable of attrition in basic initial entry training as reported here.

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ABSTRACT

Present research evaluated aspects of task performance, physical work capacity, biographical data, and psychological coping strategies, to determine their relationship to attrition and retention of personnel during a stressful training program.

It attempted to develop a selection instrument that could be utilized as part of a pre-training screening device to optimize both personnel selection and subsequent occupational assignment and training in the US Armed Forces.

Thirteen hundred men and women recruits were measured at the beginning of a recruit training period. Subsequent discriminant analysis of graduates and dropouts demonstrated significant differences on five variables correctly classifying 30% of the dropouts. These variables included physical self-comparison, reports of physical ailments (HOS), ability to cope with situational stress (RTLP), body composition and age. When these variables were subjected to a stepwise multiple regression, a predictive validity of .50 and .04 was observed for female and male dropouts respectively. Likewise, the use of multiple regression for the prediction of criterion task performances resulted in significant multiple Rs ranging from .45 to .67 using strength measurement alone.

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INTRODUCTION

A recent review (Mobley, Hand, Baker & Meguno, 1979) of the employee attrition and retention literature found a scarcity of adequate data or models for the prediction of attrition. One of the most significant omissions in the available data is the lack of multivariate analysis (Price, 1977) of variables in a longitudinal framework, as well as, the lack of criterion performance measures.

Attiriton and retention of personnel in the armed forces has been reviewed by several investigators (Hand, Griffeth & Mobley, 1977). However, their work placed greater emphasis on the nature and assessment of reenlistment (rather than attrition data), demographic (rather than task performance variables) and, a cross sectional, rather than a longitudinal, design was used. Furthermore, with the advent of the All Volunteer Army, the applicability of much of the pre-1974 research becomes question able.

The need for further research into the factors involved in attrition, retention, and the identification of these factors before a trainee enters service becomes important, as the cost of training recruits and the dropout rate increase. This problem is exemplified by the 30% attrition among enlistees in the Navy and the greater than 20% attrition during Army basic training. Recently it was reported that approximately 9% of recruits being enlisted in the Armed Forces were quickly discharged for a variety of reasons, from physical inability to perform military duties to lacking aptitude for service. The cost of this rapid attrition of recruits was placed at upwards of 190 million dollars a year.

This does not consider the intangible costs of discipline problems, administrative, and legal complications. Certainly among military managers these statistics raise concerns over the adequacy of the manpower force, both

quantitatively and qualitatively, and the cost effectiveness of the selection and training programs as currently implemented (Huck & Midlam, 1977).

The objective of this study was to evaluate the ability of these factors--physical work capacity tests, body composition, biographical data, task performance and coping skills for the prediction of premature separation from service, retention and subsequent performance on relevant training tasks.

METHODS

Subjects: The sample population in the study was composed of 854 men and 453 women undergoing initial entry training at the Fort Jackson Training Center, SC, during the months of January to March, 1978. The initial biographical, anthropometric and physical test battery data for this sample are presented in Table 1. The subjects were briefed in large groups and informed consent was obtained from those choosing to participate in the study.

Study Design: A pre-post test design was utilized. The pre-test was administered during the first week of the 7-week basic training cycle (BT), and the post-testing was done during the seventh week of the training cycle. The pre- and post-tests were identical. The basic training schedule and activities are described in detail in the Drill Sergeants Guide, dated 20 December 1977.

The program consisted of general calisthenics, running, obstacle courses and strengthening activities. All training was of a progressive nature designed to minimize injury and increase strength and stamina.

TABLE 1. MEANS AND STANDARD DEVIATIONS FOR MALE AND FEMALE RECRUITS ON DEMOGRAPHIC AND DESCRIPTIVE VARIABLES PRIOR TO BASIC TRAINING

Variables		Males (N = 854)		Females (N = 453
Comparative Fitness Level		3.0 ± .8		2.8 ± .7
Activity History		3.5 ± .9		3.2 ± .9*
Age (Yrs)		19.9 ± 2.7		20.7 ± 3.2
Educational Level (Grade)		11.5 ± 1.1		12.1 ± .9
High School Graduates (%)		69		100
Racial Composition (%Caucasian)		47		45
Height (cm)		174.3 ± 6.6		162.5 ± 6.8*
Weight (kg)		70.8 ± 10.6		59.1 ± 7.0*
Body Fat (%)		16.2 ± 5.1		27.9 ± 4.7*
Lean Body Mass (kg)		58.8 ± 6.8		42.4 ± 4.6*
Aerobic Test HR (bpm)				
HR1	20cm	125.0 ± 14.6	10cm	123.1 ± 13.9
HR2	30cm	145.7 ± 16.4	20cm	144.6 ± 15.4
HR3	40cm	165.4 ± 15.3	30cm	165.7 ± 15.0
$\dot{V}O_2$ max Predicted (ml/kg • min)		48.5 ± 3.8		38.7 ± 3.4*
$\dot{V}O_2$ max Actual (ml/kg • min)		50.7 ± 4.7		36.9 ± 3.6
Isometric Strength (kg of force)				
Legs		143.1 ± 38.3		92.0 ± 29.3*
Upper Torso		97.7 ± 18.1		55.0 ± 11.1*
Trunk		72.6 ± 18.2		47.4 ± 13.2*
Psychosomatic Complaint (HOS)		29.5 ± 6.4		31.0 ± 5.9*
Coping Strategy (RTLP)		59.1 ± 9.0		59.1 ± 8.8

* $p < .01$

Following training, the recruits were identified by their final disposition: i.e., completed basic training and sent to advance individual training (Disp 1); recycled into a subsequent basic training cycle because of missed training or illness (Disp 2); given a medical discharge due to a disqualifying injury or condition (Disp 3); or given an administrative discharge based upon an inability to adapt to training or the military environment (Disp 4). These dispositions served as the dependent measure for the study. Performance on selected criteria tasks were also used as outcome measure.

Procedures and Equipment: The components of the work capacity test battery were selected based on the following considerations. They had to be simple and inexpensive to administer. They had to be brief, safe and not excessively stressful. The test battery was designed to include major components of work capacity (i.e., stamina or aerobic power and muscular strength of the major muscle groups), measurements of body composition, exercise history, psychological coping strategy and physical self-esteem.

The cardiovascular stamina test selected was a three load continuous stepping test. It consisted of stepping at a rate of 25 steps per minute at a cadence of 100 beats per minute (full cycle) at three of four possible step heights: 10, 20, 30, and 40 cm levels. The work loads selected covered the range of work capacity used to predict performance. This procedure allowed for comparability of heart rate measures between male and famale subjects, i.e., the rates were in the range of 120-170 beats/minute. The test continued for three minutes at each level and proceeded immediately to the next level without interruption. The stepping apparatus can be seen in detail in Fig. 1. The predicted stamina values ($\dot{V}O_2$ max), in ml/kg min were validated using a modification of a treadmill technique described elsewhere (Patton, Daniels & Vogel, 1980).

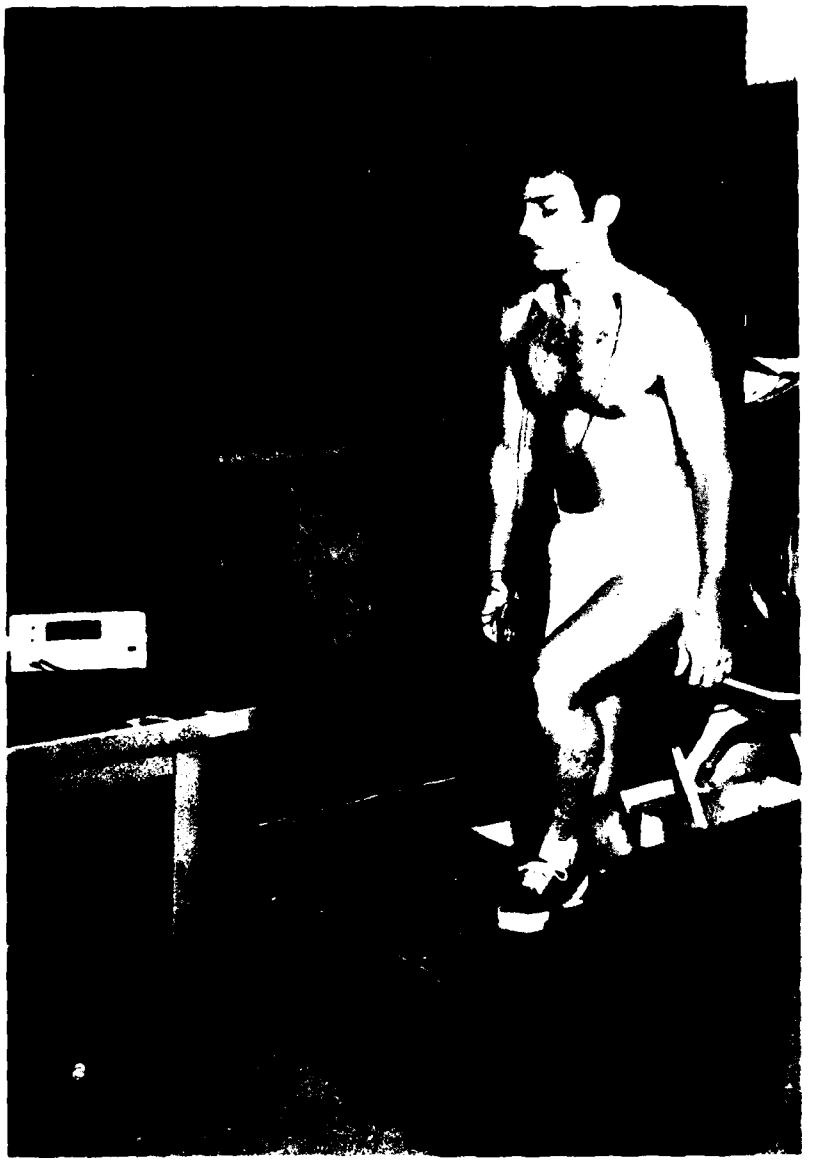

Figure 1. Subject performing stepping test with heart rate monitor attached.

The design for our isometric strength device was based on equipment originally developed for the Norweigan Army (Hermansen, Ericksen & Larson, 1972) for a similar purpose. However, for our application is was necessary that all measurements be incorporated into a single free standing device. Details of the device, procedures, and reliability data are discussed in another publication (Knapik, Kowal, Riley, Wright & Sacco, 1979). The strength measures included those of the leg extensors (Fig. 2) of the upper torso (arms and shoulders) (Fig. 3), and the trunk flexors (Fig. 4).

Few studies have been done using actual military tasks as criteria for evaluating the efficacy of pre-induction test battery. However, several investigators (Nordesjo & Schele, 1974) have found that isometric strength tests did predict performance on certain work tasks and overall physical work capacity. Based on an analysis of the components of muscular strength by Borchardt (1968), we developed an isometric strength apparatus for the assessment of the muscular strength of recruits (Knapik, et al., 1979).

In addition to the standard height and weight measurements, body composition was estimated by using skinfold technique and the equations of Durnin and Wormesley (1974).

The psychological instruments included the Health Opinion Survey (HOS) which assesses the individual's predisposition to psychosomatic ailments (McCarroll, Kowal & Phair, 1981), and, the Response to Life Problems (RTLP) which assess a person's ability to mobilize internal resources to cope with environmental or situational stress.

Activity history (previous athletic participation) and comparative fitness (self perception of fitness) relative to others of the same sex and age prior to entering training were figured on a 5 point scale: 1 equal to low activity or fitness up to 5 which equals high activity or fitness.

Figure 2. Standard positioning for the measurement of leg extensor strength.

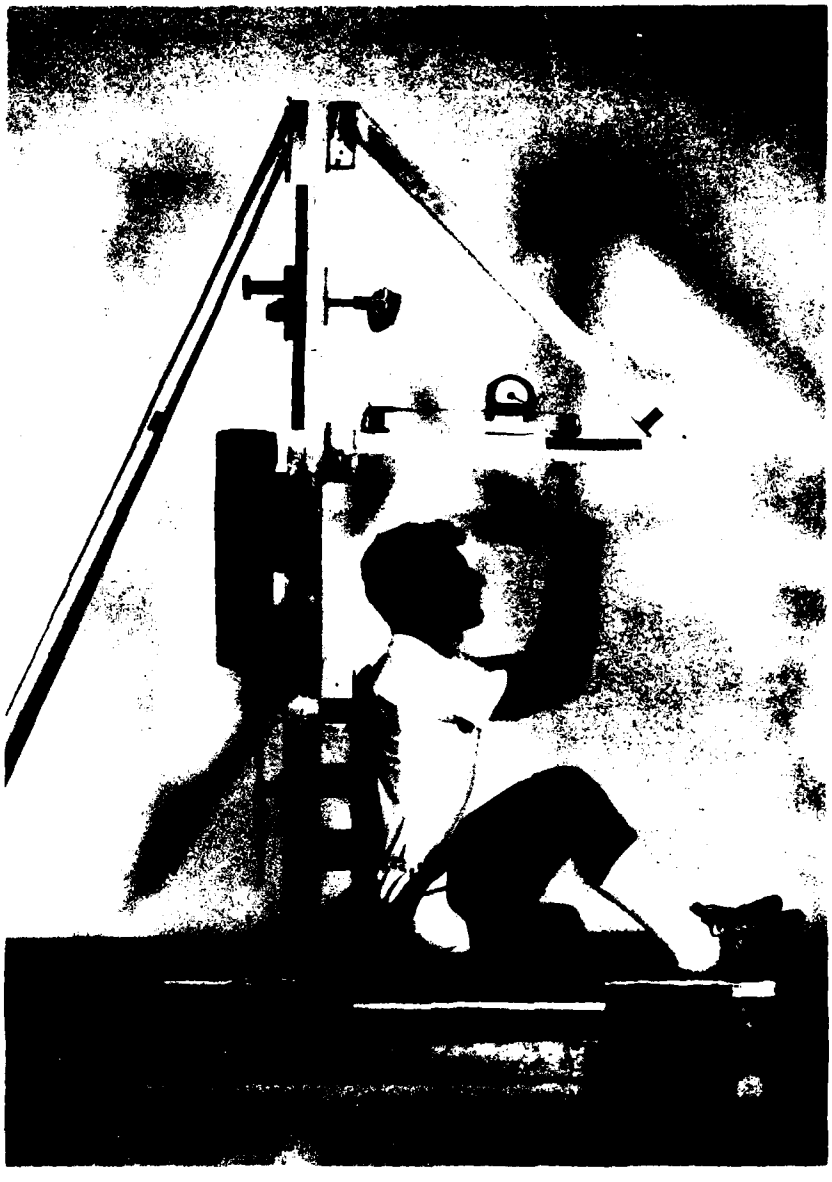

Figure 3. Standard positioning for the measurement of upper torso strength.

Figure 4. Standard positioning for the measurement of trunk flexor strength.

A modified Army Physical Fitness Test (APFT) and a series of Common Soldiering Tasks (CST) were the primary task performance criteria. The tasks were selected by the Infantry School at Fort Benning, Georgia, as representing basic skills and capacities that every soldier must possess before completing basic training. The tasks are outlined in Table 2. These tasks were administered during the final week of the training cycle and the performance scores recorded.

The statistical analyses consisted of 1) univariate comparisons of trainees classified into two groups: successful completion of basic training (GP1) or discharge from service due to medical or administrative reasons (GP2); 2) discriminate function analysis based on this two fold classification, and 3) a multiple regression analysis using the pre-training test battery measuremen for the prediction of criterion tasks performance at the completio of basic training.

RESULTS

Over the course of the 7-week basic training, the attrition rate was 12% for both men and women.

Table 1 presents a summary of the data collected during the pre-training assessment. These work capacity and strength measures displayed a significant difference between males and females. However, this is to be expected since women have, on the average, 20-25% less lean muscle body mass than men.

Figure 5 demonstrates the comparative relationship that exists for selected physical measures. These percent discrepancies were reduced following training since women usually start training at lower levels of their physical potential and improve more in response to a training program.

TABLE 2. STEPWISE MULTIPLE REGRESSION OF RECRUIT PERFORMANCE ON CRITERION TASKS AT THE END OF TRAINING WITH TEST BATTERY PERFORMANCE PRIOR TO TRAINING

	VARIABLES	R	R^2
a) Fitness Test			
One Mile Run	Leg Strength + Upper Torso	-.59	.35
Push ups	Upper Torso + Leg Strength	.56	.31
b) Common soldiering task			
Road March w/equipment 8 km	Leg + Upper Torso Strength	-.51	.26
Dig 3x5x1.5 ft. Emplacement	Upper Torso + Trunk Strength	-.45	.21
Lift & Carry 8 Sand Bags 22 kg 50 m	Upper Torso Strength	-.62	.39
Low-High Crawl 75 m	Upper Torso Strength	-.67	.45
Dash 75 m	Upper Torso Strength + Leg Strength	-.67	.45

[1]Pre-baseline training program for basic training. US Army Infantry School, Ft. Benning, GA Sep 77.

Table 3 presents a comparison for men and women based on whether they completed basic training (GP 1) or were discharged from service (GP 2).

Following initial analysis, Disposition 1 and 2 (completed basic training or were recycled) were identical, both in actual training outcome (both groups compelted basic training) and, statistically, i.e., in mean scores across the test battery. Therefore, they were consolidated for analysis as having completed training (GP 1).

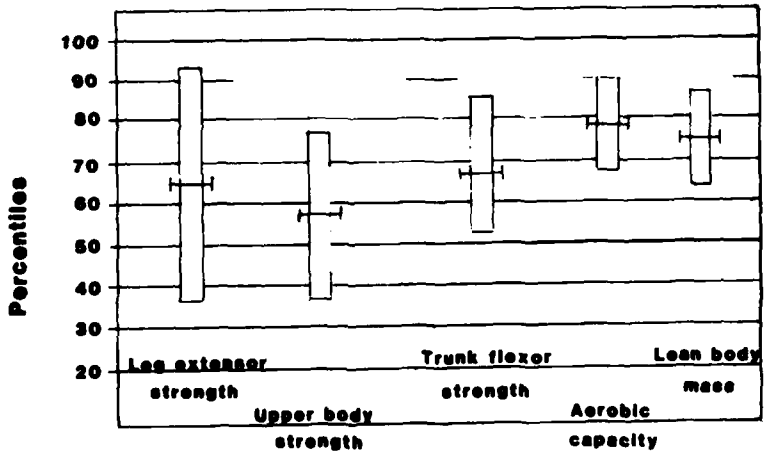

Figure 5. Comparison of males and females on selected physical measures. Bars represent means and 1 SD range of measured factor for females as compared to males.

TABLE 3. MEANS AND STANDARD DEVIATIONS FOR DEMOGRAPHIC AND DESCRIPTIVE VARIABLES FOR RECRUITS COMPLETING BASIC TRAINING (GP1) AND THOSE DISCHARGED FOR MEDICAL OR ADMINISTRATIVE REASONS (GP2) COLLECTED PRIOR TO TRAINING

	Males		Females	
Variable	(N = 751) Completed Basic	(N = 103) Discharged	(N = 399) Completed Basic	(N = 54) Discharged
Comparative Fitness Level	3.07 ± 0.8	2.79 ± 0.9**	2.86 ± 0.7	2.54 ± 0.8**
Activity History	3.50 ± 0.7	3.27 ± 1.1*	3.25 ± 0.9	2.98 ± 0.9*
Age (yrs)	19.9 ± 2.6	20.1 ± 3.3	20.61 ± 3.1	21.2 ± 3.4**
Height (cm)	174.3 ± 6.5	173.78 ± 6.6	162.66 ± 6.7	162.5 ± 7.5
Weight (kg)	70.8 ± 11.7	68.9 ± 11.2	59.0 ± 7.2	59.6 ± 7.0
Body Fat (%)	16.2 ± 5.1	16.4 ± 6.1	27.9 ± 4.7	28.1 ± 5.6
Lean Body Mass (kg)	59.0 ± 6.8	57.2 ± 6.5**	42.3 ± 4.3	42.4 ± 3.9
Aerobic Test HR (bpm)				
HR1	122.5 ± 13.6	124.8 ± 13.2	124.6 ± 14.6	126.4 ± 13.9
HR2	142.2 ± 14.1	145.0 ± 15.0	145.7 ± 16.0	147.9 ± 15.0
HR3	162.3 ± 15.0	165.7 ± 15.6	165.8 ± 15.3	167.6 ± 14.3
$\dot{V}O_2$ max predicted (ml/kg/min)	49.4 ± 3.5	47.2 ± 3.9	38.9 ± 3.5	37.9 ± 4.6
Isometric Strength (kg)				
Leg	143.3 ± 38.5	136.0 ± 34.3**	92.7 ± 19.6	86.4 ± 27.4**
Torso	97.5 ± 18.1	92.4 ± 22.6**	55.3 ± 11.4	53.0 ± 9.0
Trunk	72.5 ± 18.3	71.8 ± 19.7	47.8 ± 13.1	44.7 ± 13.9**
HOS	29.2 ± 6.1	31.4 ± 8.1**	30.8 ± 5.9	32.6 ± 6.0**
RTLP	59.5 ± 8.8	56.8 ± 10.2**	59.2 ± 8.9	57.7 ± 8.3**

*p< .05

**p< .01

Likewise, Disposition 3 and 4 (discharged for either medical or administrative reasons) were consolidated for analysis (GP 2) because both were discharged from service although for different reasons. The groups differed significantly on the variables (HOS scores, comparative fitness levels, age, strength of legs and trunk, and lean body mass) of the test battery (Table 3). However, the fact that only 12% of the sample were in GP 2 created a substantial discrepancy in sample size and a subsequent restriction of range reducing the degree of relationship.

Since variables may be interrelated in a test battery such as this, a multivariate analysis technique was used to assess which combination of variables optimally discriminated between the two groups.

A stepwise discriminate analysis BMDP7M (Dixon, 1975) was used to identify the underlying dimensionality and the contributio of individual variables to the prediction of recruit retention and attrition (Table 4).

The discriminant functions were significant and differentiated the two groups using 5 of the variables for the combined male and female groups. Physical self-comparison, the MOS, and age at entry into training were included in all the discriminant functions. Classification matricies are presented in Table 5. These tables provide an indication of the efficacy of these discriminant functions.

TABLE 4. SUMMARY TABLE OF STEPWISE DISCRIMINANT ANALYSIS FOR RECRUITS COMPLETING BASIC TRAINING (GP1) AND RECRUITS DISCHARGED (GP2) FROM SERVICE

FEMALE

Step	Variables	Approximate F-Statistic	DF	Significance Level
1	Comparative Fitness	9.66	1/451	.01
2	HOS	6.20	2/450	.01
3	Age	4.92	3/449	.01
4	Trunk Strength	3.97	4/448	.01
5	Leg Strength	3.30	5/447	.01

MALE

Step	Variables	Approximate F-Statistic	DF	Significance Level
1	HOS	11.09	1/852	.001
2	Comparative Fitness	9.02	2/851	.01
3	LBM (kg)	7.82	3/850	.01
4	RTLPA	6.65	4/849	.01
5	Age	5.56	5/848	.01

MALES AND FEMALE COMBINED

Step	Variables	Approximate F-Statistic	DF	Significance Level
1	Comparative Fitness	20.24	1/1319	.001
2	HOS	14.88	2/1318	.001
3	RTLPA	10.86	3/1317	.001
4	Age	8.61	4/1316	.01
5	Body Fat (%)	7.17	5/1315	.01

TABLE 5. CORRECT CLASSIFICATION USING DISCRIMINANT FUNCTIONS OBTAINED FROM RECRUITS COMPLETING BASIC TRAINING (GP1) AND RECRUITS DISCHARGED (GP2) FROM SERVICE

	PERCENT OF CORRECT	NUMBER OF CORRECT
MALES		
CLASSIFICATION CLASSIFICATION		
Completing Basic Training	87.6	658/751
Discharged From Service	29.1	30/103
Total Correct Classification	80.6	688/853
FEMALES		
Completing Basic Training	87.7	350/399
Discharged From Service	29.6	16/54
Total Correct Classification	80.8	376/452
MALES AND FEMALES COMBINED		
Completing Basic Training	88.6	1029/1161
Discharged From Service	25.0	40/160
Total Correct Classification	80.9	1069/1319

In the male and female combined group, the function correctly classified 88.6% of GP 1 but only 25% of GP 2. When the classification was done for males and females separately, the discriminant function demonstrated an almost identical correct classification for men and women (men, 87.6%; women 87.7%) completing basic training and for those discharged, (men, 29.1% and women, 29.6%). The major reasons for administrative discharge were either unsuitability for service due to apathy, aptitude, or failure to adjust to the military life.

A multiple regression analysis was performed with the variables presented in Table 4 to partition the variance associated with attrition. Predictive validity was .50 and R^2 (variance accounted for) was 25% for the prediction of female recruit attrition, but accounted for only 4% for the prediction of male dropouts. It must be kept in mind that these data have a base rate and selection ratio that makes prediction difficult, i.e., no information on the base rate and a selection ration of .88.

To evaluate how well these work capacity test measurements uniquely co-varied with criterion task performance, a stepwise multiple regression analysis was done (BMDP2R). This provided the best linear combination of variables for the prediction of performance on specific criterion tasks. Table 5 summarizes the results of these analyses.

As can be seen, upper torso strength contributed significantly to the prediction of several of the performance tasks. It was responsible for the greatest percentage of the variance in task performance for the combined group of trainees.

However, other components of the test battery also contributed to the prediction of task performance. In order of contribution to the predictive equations, these were leg strength and trunk strength. Multiple regression with two variables provided R values from .45 to .67, all of which were significant at $p < 5.01$.

DISCUSSION

The US Supreme Court mandated in the Civil Rights Act of 1964 that performance based criteria would be required for acceptable validation of a selective device, and that such a test would be considered discriminatory if its validity in predicting job performance could not be demonstrated. We have attempted to develop such a performance based assessment device, for the selection of military personnel and their subsequent MOS classification.

However, the analysis of the potential benefit in terms of cost effectiveness and the application of the complete spectrum of MOS categories remains to be accomplished.

This study attempted to merge the recruitment, selection and training technologies with information about military tasks and the scientific data on work capacity. This was done to develop a test battery that would optimize personnel selection, training, and assignment.

The implications for the military are many. Specifically, it is important to identify 1) the optimum level of work capacity for different military jobs, 2) the level of recruit work capacity prior to training that is necessary to insure adequate criterion task performance and successful completion of the training program, 3) the improvement in work capacity that can be expected during a prescribed period of training, and 4) identify how the moderator variables (gender) may influence selection and assignment.

The results of this study revealed that among the sample of men and women entering the service, there were a number of significant differences in physical, anthropometric, and demographic factors. Some of these appeared to be quite valuable for differentiating those personnel who could withstand the rigors of military basic training from those who would prematurely drop out.

As can be seen in Table 3, prior to the beginning of training, dropouts differed significantly on many of the measures taken for both men and women. Specifically, the 12% who were subsequently released from service reported lower levels of physical fitness when asked to compare themselves with other men or women of their own age.

The women who dropped out reported lower levels of previous physical activity, and had lower levels of strength in the major muscle group. Likewise, the men who were dropouts displayed lower levels of strength and lean body mass.

Psychologically, the dropouts had a greater tendency for psychosomatic illness and reported fewer psychological mechanisms to cope with situational stress. These findings support previous research on the role of attitudes about oneself as being about the best predictors of job attrition (Kraut, 1975).

In an effort to refine further the predictive validity of these measures, a discriminant function analysis was performed on these data. This was done to determine how well the pretraining variables correctly classified the trainees into either the dropout or successful completion category.

The correct classification of dropouts was approximately 30% and about 89% for those who compelted basic training. However, the probability of misclassification remains prohibitive with the high selection ration that is determined by policy rather than performance assessment.

The predictive function included a number of different variables which illustrates the utility of a multivariate analysis over the simple regression approach. Likewise, the significant contributions of physical self-assessment and strength measures suggest that these factors may be valuable adjuncts for inclusion in a pre-training screen. This could reduce attrition and assist in the identification of individuals who may benefit from some pre-training instruction

or supervision. This notion has been further substantiated in a related publication (Kowal, 1980) which showed that these factors also identified trainees who were susceptible to training injury and subsequent medical discharge.

Although a predictive validity of 0.50 is considered reputable, these variables accounted for about 25% of the variance for women but only 4% for the men who were dropouts. The lack of a stronger covariance was disappointing, although it may have several explanations. First, the fact that 12% of the sample dropped out of training created a rather severe split in the sample population and imposed a restriction of range limitation on the data. Likewise, these recruits had already gone through several other screenings, which promoted homogeniety within the sample, especially the men. Further, the practice of consolidating the dropouts into one category resulted in a contaminated criterion measure since the administrative dropout and the medical dropout had different precursors (though both represent a loss to the military in terms of training costs).

However, to subdivide further the dropouts would result in a drastic reduction in the sample size and was therefore not done. The fact that the criterion data was collected for only a period of 7 weeks (the recruit training period) further depressed the relationship. This could be improved upon if the sample could be followed into the second phase of training and first enlistment completion, where job performance becomes paramount.

Another factor which limited our prediction of attrition was that policy decisions are mandated periodically. These either restrict or expand the acceptable level of recruit attrition. These policy decisions may actually exist at the unit level and confound any attempt at the analysis of attrition.

Although the correct classification of dropouts was 30%, this can be deceptive since the proportion of the entire sample that dropped out was relatively small (12%). Likewise, a predictive model that is designed to optimize selection in a probabilistic or Bayesian manner has certain limitations. This may make the model appear of minimal practical value (16% improvement in correct prediction of attrition compared to no screening at all). However, this improvement in predictive utility is not trivial from the managers point of view. Especially, when the adequacy of the manpower force and the cost effectiveness of the training program are being questioned. Although, its use as a decision making tool for selection may not be warranted, it must be recognized that other factors besides the validity of the test battery, are contributing to the low predictive utility of this model, i.e., selection ratio and base rates. These are essentially organizational decisions regarding recruitment policies and manpower requirements that set unrealistic constraints upon any predictive model. In fact, the ability to predict even this comparatively small number of dropouts has practical significance when the escalating costs of manpower recruitment and training are considered.

The present study also attempted to evaluate the prediction of performance on relevant military criterion tasks to identify pre-training variables that might predict subsequent criterion task performance. This could also provide a normative basis for the development of standards for specific job categories. In almost all cases, the pre-training measures accounted for 30-45% fo the variance of task performance. This is quite good considering the low reliability usually found in field performance testing of criterion tasks. The use of multiple regression proved useful since two variables contributed significantly the prediction of performance on several of the criterion tasks. The fact that the upper torso (arms and shoulder) strength accounted for much of the variance

in the tasks suggests the need for high upper body strength in the performance of these and therefore probably other military tasks. This finding may be a major complication for the assignment of women into physically demanding job classifications, since most women have their greatest weakness in this muscle group compared to men (See Fig. 5). In fact, upper body strength, rather than cardiovascular endurance or stamina, may be the limiting factor in the performance of many military tasks. It is encouraging that the values presented here for the prediction of performance tasks from isometric measures are comparable to those reported in the literature for similar military tasks (Hermansen, Ericksen & Larsen, 1972). Unfortunately, we do not have adequate measures of the motivational component of any individual's work performance, knowledge of which would undoubtedly increase our predictive validity.

It should be kept in mind when looking at these data that it is impossible to *compare them* with others from the literature or even to different groups of recruits since the high correlation found were not always accompanied by low standard errors (se) of measurement. Likewise, in a period of transition, when the nature of the population from which we draw new accessions into the military is changing, there is no assurance that the predictive equations generated here are valid for populations other than those they have developed upon. Therefore, continued revalidation is necessary to insure their utility. Moreover, this caveat must also apply to models based on optimized differences between groups, when selection is based on policy decisions and necessity rather than any objective criterion of success. Therefore, this mdoel cannot be endorsed as valid until the factors that provide the basis for validity determination (i.e., base rate, selection ratio, etc.) are established.

But, the present results are sufficient to provide the basis for several generalizations and recommendations. Most important, it has been shown that

recruit attrition is related to pre-training variables that can be assessed at the entrance examination station. These variables include the following factors: physical self comparison, report of physical ailments, ability to utilize coping strategies to deal with situational stress, body composition, and the age of the individual upon entry into basic training. These data suggest that dropouts, when compared to recruits who successfully complete training, have lower physical self assessment in terms of their comparative fitness levels, and were more likely to report physical ailments or maybe more likely to experience them, noting their relatively poor level of physical fitness. Also, they tended to lack the psychological techniques to deal with the stressful regimen encountered during basic training. The dropouts were also characterized by greater body fat.

In this study, greater body fat was found to be strongly correlated with endurance capacity, being the principle variable in our predictive equation for aerobic capacity. This points to endurance capacity as an essential ingredient for successful completion of training. This relation between greater body fat and lower endurance capacity verifies the dropout's self reported low fitness level. It is interesting to note that the older recruits were more likely to become dropouts. It is hard to determine whether they may have been more susceptible to injury which has been suggested in another study (Kowal, 1980) or whether they were less willing to tolerate the rigors of military life and subsequently discharged for administrative reasons.

It is not surprising that the variables entering the predictive discriminant function were for the most part psychological or perceptual in nature. It seems evident that ones perception and psychological response to a stressful environment or situation will be the primary determinants of an individual's adaption to that situation, though the lack of physical work capacity or strength may in part be the basis for this cognitive assessment.

The use of test batteries for selection of personnel have typically been designed to measure specific abilities rather than general capacities. Our test battery was specifically designed to measure basic parameters of work capacity (strength of major muscle groups, stamina), anthropometric and physical self assessment variables that would theoretically underlie all task performance. These measures of work capacity could then be generalized to other tasks or constraints, i.e., continuous performance, heat, cold, darkness or emergency conditions in the operational setting. However, for this to be accomplished 1) the tasks have to have been thoroughly analyzed and a taxonomy developed, along the lines proposed by Fleishman (1975) or the Dictionary of Occupational Titles and 2) the test battery factors would have to be selected and given appropriate weighting in terms of their predictive power.

The promise of generality is the principle advantage of this approach. But, it depends on the development of the necessary task-taxonomies to be accomplished if it is to be applied to the whole spectrum of military occupations. This study, though not definitive by itself, serves to emphasize the need for multidimensional, longitudinal, task referenced performance analysis in the development of a test battery. It also suggests that a pre-training assessment of these factors during the induction screening procedure could provide an estimate of performance on criterion tasks currently considered essential for all military recruits, and reduce attrition, with only a small increase in screening cost.

In conclusion, it must be kept in mind that the overall utility of an assessment battery depends not only on the validity of the test battery but also on the selection ratio, availability of the criterion task scores and the cost of the assessment procedure. Likewise, the optimum selection strategy may not be optional for the other organizational functions such as recruiting, training and

manpower needs. Therefore, any selection strategy must be evaluated in terms of its total contribution to the organization or its overall utility. However, this can be extremely difficult to calculate unless the objective basis of cost effectiveness is employed and only then will managers be able to evaluate the consequence of an alternate selection strategies.

REFERENCES

1. Borchardt, J.W., A Cluster Analysis of Static Strength Tests. Research Quarterly. 1968, 39, 258-261.

2. Dixon, W.J. (ed). BMD Biomedical Computer Programs, BMDP Series, Los Angeles, CA. 1975.

3. Durnin, J.V.G.A. and Wormesley, J.W. Body Fat Assessed from Total Body Density and Its Estimation from Skinfold Thickness: Measurement on 481 Men and Women Aged from 16 to 72 Years. British Journal of Nutrition. 1974, 32, 77-92.

4. Fleishman, E.A. Toward a Taxonomy of Human Performance. American Psychologist. 1975, 30, 1127-1149.

5. Hand, H.H., Griffeth, R.W. and Mobley, W.H. Military Enlistment, Reenlistment and Withdrawal Research: A Critical Review of the Literature. Office of Naval Research Technical Report No. 3. April 1977, (ONR TR3).

6. Hermansen, L., Ericksen, O. and Larsen, C. Apparatus for Rating Isometric Muscular Strength. Journal of the Norweigan Medical Association. 1972, 4, 1-8.

7. Huck, D.F., Midlam, K.D.A. A Model to Analyze the Cost of First Term Attrition in the Navy and Marine Corps. In H.W. Sinaiko (Ed.) First Term Enlisted Attrition. Washington, DC. Smithsonian Institution, 1977.

8. Knapik, J., Kowal, D., Riley, P., Wright, J. and Sacco, M. Development and Description of a Device for Static Strength Measurement in the Armed Forces Entrance and Examination Station. USARIEM Technical Report No.. Jan 1979, T 2/79.

9. Kowal, D.M. The Nature and Causes of Injuries in Women Resulting from an Endurance Training Program. American Journal of Sports Medicine. 1980, 8(4), 265-269.

10. Kraut, A.I. Predicting Turnover of Employees from Measured Job Attitudes. Organization Behavior and Human Performance. 1975, 13, 233-243.

11. McCarroll, J.E., Kowal, D.M. and Phair, P.W. The Health Opinion. urvey: Predicting Illness in Military Trainees. Military Medicine. 1981, 146, 463-468.

12. Mobley, W.H., Hand, H.H., Baker, R. and Meguno, B. Conceptual and Empirical Analysis of Military Recruit Training Attrition. Journal of Applied Psychology. 1979, 64, 10-18.

13. Nordesjo, L.O. and Schele, R. Validity of an Ergometer Cycle Test and Measures of Isometric Strength when Predicting Some Aspects of Military Performance. Forsvarsmedicin. 1974, 10, 11-23.

14. Patton, J.F., Daniels, W.L. and Vogel, J.A. Aerobic Power and Body Fat of Men and Women During Basic Training. Aviation, Space and Environmental Medicine. 1980, 51, 492-496.

15. Price, J.L. The Study of Turnover. Ames: Iowa State University Press, 1977.

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